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ABSTRACT

A study was conducted to assess teaching in minority engineering programs, based on 38 engineering institutions with special programs for disadvantaged minorities. The institutions were investigated with respect to preferences, characteristics, and preparation of teachers and the availability of faculty development for special program teachers. The programs include developmental, academic support, tutoring, and compensatory education. Special programs function at the precollege and undergraduate levels. Information is presented on program effectiveness, program structure, review sessions, academic procedures, and counseling. The survey obtained information on the kinds of teachers selected for the special programs and their teaching preferences. Teaching strategies preferred by special program teachers and correlations between special teaching methods and student retention and student academic success are discussed. Recommendations are offered based on survey findings. (SW)

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TEACHING THE DISADVANTAGED IN ENGINEERING

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Retention of disadvantaged students is a major problem in engineering schools. Educators have been successful in recruiting students, but relatively unsuccessful in providing the resources and services to help retain students. In order to increase the number of minority students in engineering programs, schools have recruited many educationally disadvantaged students. Unfortunately, most of these students have been poorly prepared in high school. A report by Ron Simmons demonstrated that retention is a multi-faceted problem requiring many components working in consort such as counseling, financial support, teaching, and recruiting. Further, important considerations are the attitudes, preparation, and teaching strategies of educators. Good teaching is by no means a panacea, yet it is an essential ingredient in education.

DISCOVERING GOOD TEACHERS

The present investigation attempts to assess teaching in minority engineering programs. A survey of one-hundred five engineering institutions with special programs for disadvantaged minorities were investigated with respect to preferences, characteristics and preparation of teachers,

as well as the availability of faculty development for special program teachers.

TEACHING PROBLEMS IN HIGHER EDUCATION

The teaching component has become a major focus of much of the recent literature on higher education. Fairly new problems have become significant, such as declining enrollments, the tenure issue, retrenchment, high student attrition, lack of training for faculty and graduate students, communication problems among faculty and staff, and bandwagonism and faddism. Other problems are equally significant such as measuring scholarly activities, lack of emphasis on life experiences, poor teaching and advising, overemphasis on the doctorate, and the concept of equal opportunity.

The writers will focus on five problems. First, students are admitted, whether qualified or not, the institution has made a commitment to educate these students, and special programs have been organized to provide these services utilizing specially trained administrative and counselling staff. Many institutions, however, use regular faculty who may have no special interest and may also lack the experience needed to teach special students. Even though most traditional faculty are sincere and recognize the need for additional training, many have no special training program in which

to participate. Warren Bryan Martin believes that the 40% attrition of the cohort group from freshman to senior year (sometimes higher in engineering) is attributed to poor teaching and advising--the two major areas of contact between faculty and students. Special programs have been exemplary in providing experimental techniques to reduce attrition often adopted by their institutions.

Second, teaching is assigned a low order of priority by faculty, because scholarship, (i.e., research and publishing) is considered by administrators and peers to be more important for faculty advancement. Scholarly activities, until recently, have been the most important measure of teaching ability, literally ignoring the impact of teaching on students. At some institutions, research is a more important criterion for promotion than teaching ability. William Toombs states that this situation is further complicated by the project approach to research used by research agencies such as the National Science Foundation and the Department of Energy. Thus, faculty learn to prioritize: Teaching may be intrinsically rewarding, but not profitable, in terms of professional advancement..

Third, with the present enphasis of most graduate

programs on training scholars and researchers, Ph D. candidates are not prepared to teach after graduation, assert Michael Melnick and Daniel Sheehan. Brother Austin Barry states further that since administrations insist upon the possession of the doctorate as a sine qua non, the engineering profession, especially in recent months, is emphasizing a requisite background in professional practice. Consequently, many new teachers, convinced that teaching comes naturally, develop the "talking tradition" where they lecture in mastered content area.

Fourth, the traditional approach to education does not always help the non-traditional student, such as ethnic minorities, adults and under-represented groups. Kenneth Eble in an epic work on teaching titled Professors as Teachers, states that procedures and strategies for new college teachers are lacking. Exposure to these new procedures is not always possible because there is often little preplanning by graduate students to teach upon graduation. This situation is further complicated by an attitude toward graduate teaching in that, (1) faculty are overcommitted, (2) education as a discipline is not respected in many circles, (3) many educators question whether or not teachers can be taught

and (4) subject matter acquisition is considered by many educators to be the best training for teachers. But, teaching has other benefits. Ann Weiss states that good graduate teaching experiences can heighten one's awareness of teaching.

On the other hand, good teaching is difficult to achieve, because some teachers resist change. The Group For Human Development in Higher Education states that most college teachers do not have the knowledge or skills to become better teachers so they resist efforts to change. Moreover, teachers face change in respect to the generation gap. Edward Lonsdale comments that there are differences between student and teacher goals and that faculty perceive students as (1) merely wanting to obtain good grades and a degree, (2) needing to obtain technology that certifies learning and (3) wanting training as "doers," developing applications. At the same time, faculty devalue the importance of the degree and grades, want study for its intrinsic value, and emphasize theory and decision making. Also, there is a misinterpretation of rules and concepts. To students, <u>understanding</u> means follow the text book line by line, not interpreting, reflecting and synthesizing, thus, the word study means merely memorization.

Most students developed bad study habits in high school , and these students may fail because they do not understand the new rules and roles in college. Lonsdale states that most grading in high school is based on memorization skills.

Intuitively, program managers have attributed successful student performance to good teaching, but no concrete link has been proferred. However, almost every administrator of a special program can produce evidence that poor students with good potential can improve academically with proper support.

Finally, some students blame poor academic performance on insensitive teachers who do not have the patience to explain difficult concepts and who have biased attitudes toward disadvantaged students.

SURVEY FINDINGS

One-hundred-five questionnaires were mailed to engineering institutions believed to have support programs for minorities. Thirty-eight schools responded indicating a special program on campus. Those schools responding represented a broad geographic area (see Table I). Five schools responded from

Table I
Geographic Area

n=38/105=36.19

Northeast	Frequency	% respondents	% population
Massachusetts	4	10.53	3.81
Rhode Island	1	22.63	.95
New Jersey	3	7.89	2.86
New York	4	10.53	3.81
Pennsylvania	2	5.26	1.91
Total	14	36.84	13.34
South			
Alabama	3	7.89	2.86
North Carolina	2	5.26	1.90
Tennessee	2	5.26	1.90
Virginia	1	2.63	.95
Maryland	1	2.63	.95
Oklahoma	1	2.63	.95
Texas	2	5.26	1.91
Total	12	31.56	11.42
North Central			
Indiana	1	2.63	.95
Illinois	1	2.63	.95
Michigan	2	5.26	1.91
Missouri	1	2.63	.95
Ohio	1	2.63	.95
Wisconsin	2	5.26	1.91
Total	8	21.04	7.62
West			
California	3	7.89	2.86
Montana	1	2.63	.95
Total	4	10.52	3.81
Grand Total	38	99.96	36.19

the Northeast, seven schools from the South, six from the North Central area and two from the West.

INSTITUTIONS WITH MINORITY ENGINEERING PROGRAMS

Six types of institutions responded indicating a special program in operation (see Table II). Most programs are housed in state or private universities. This finding is rational since these insitutions may have more resources and facilities to provide comprehensive support. Four year institutions make up the remainder of major schools reporting.

Table II
Types of Institutions

Frequency	Type	% respondents	% total
14	State Univ.	36.84	36.84
10	Private Univ.	26.31	26.31
7	4 yr.Pub. Coll.	18.42	18.42
5	4 yr.Indep. Coll.	13.15	13.15
1	2 yr. Coll.	2.63	2.63
1	Pre-College	2.63	2.63

TYPES OF ENGINEERING SUPPORT PROGRAMS

There are a variety of programs for disadvantaged minority students in engineering. These programs include developmental, academic support, tutoring and compensatory education. Developmental programs provide transitional courses. Academic support programs provide grade monitoring, an early warning system, counseling and faculty run review sessions. Tutoring programs are organized providing program staff and/or trained graduate students to provide individualized instruction. Compensatory programs, similar to academic support programs, provide supplemental courses for students.

Many programs combine tutoring and academic support (24.3%), developmental, academic support and tutoring (21.6%) and tutoring (13.5%). However, developmental and compensatory programs do not function independently in most institutions,

Table III
Type of Program

Frequency	Type of Program	%respondents	% total
9	Academic & Tutoring	24.32	23.68
8	Develop. & Acad.Supp. & Tutoring	21.62	21.053
8	Develop. & Tutoring	21.62	21.053
5	Tutoring	13.51	13.158
3	Developmental	8.11	7.89
2	Academic Support	5.40	5.26
2	Compensatory	5.40	5.26

LEVEL OF PROGRAM

Special programs function at two levels: pre-college and undergraduate. Most institutions indicated individual programs, although combinations and affiliations can strenghten services and give pre-college students a feeling of familiarity with the institution and the faculty thereby providing a better support mechanism. There are nine programs (25%) that combined pre-college and undergraduate support, but twenty programs (55%), concentrate on undergraduate support (see Table III). Seven programs (19.4%) emphasized pre-college preparation.

Table IV
Level of Program

Frequency	Level	% respondents	% total
20	Undergraduate	55.55	52.63
9	Pre-coll.& Undergrad.	25.00	23.68
7	Pre-college	19.44	18.42

PREPARATION OF STUDENTS

Many factors are necessary in order to predict academic success, no matter what kind of support exists. These factors include knowledge of academic background, academic support, and diagnostic measures. Table V shows that respondents are almost evenly split on the level of preparation of entering students: Forty-eight percent believe preparation is adequate, while fifty-one percent believe it is inadequate (see Table V). The former condition would justify a special program concentrating on supportive rather than remedial services.

Table V
Preparation of Students

Frequency	Preparation	% respondents	% total
18	Adequate	48.64	47.36
19	Inadequate	51.35	50.00

PROGRAM EFFECTIVENESS

Ninety-three percent of the respondents believe that their program has been successful in retaining students although they are split over their ability to predict success (see Table VI). Fifty-two percent believe that they can predict academic success, while forty-seven percent say they cannot predict success. When asked if students would survive without the program, 54% of the respondents think students would not, 5% believe students would survive, but 40% think they would probably survive. The authors suspect that the latter response is a question of preparation and degree: If students have had good preparation, especially in a comprehensive pre-engineering profram[9], their chances for success are greatly enhanced.

Those who survived without training would be few since survival is measured by the completion of the degree requirements and the quality of training.

Table VI
Program Effectiveness

Frequency	Item	% respondents	% total
28 yes	Program Effect.	93.33	73.68
2 no	"	6.66	5.26
18 yes	Predict Academic	52.94	47.36
16 no	Success	47.05	42.10
2 yes	Student Survival	5.40	5.26
20 no	"	54.05	52.63
15 prob.	"	40.54	39.47

PROGRAM STRUCTURE

Most programs report structured formats (see Table VII). Specifically, twenty-three percent of the respondents indicated that their tutoring and review sessions are structured, (i.e., with scheduled activities and designated staff), or termed "organized." Some program respondents indicated a procedure for student participation as voluntary or mandatory. Voluntary programs make attendance and participation the responsibility of the students. Mandatory programs ,on the other hand, require participation, assuming that educationally disadvantaged students need study supervision and scheduled contact with staff. Forty-four percent of the teachers described their programs as organized. Teachers expressed little preference for "unorganized" programs: a term describing a tutoring program where students telephone tutors when they need help. This approach would seem undesirable since teachers and program managers have little supervision over academic support mechanisms and student progress. Programs similar to the Minority Engineering Program at Cornell University, and the Office of Minority Education at the Massachusetts Institute of Technology and the C-MAP Program at Carnegie-Mellon, are most effective. Programs that encourage participation through strong leadership seem to work best.

Table VII
Program Structure

Item	Frequency	% respondents	% total
Organ./Voluntary	17	44.737	44.737
Organized	9	23.684	23.684
Voluntary	6	15.790	15.790
Organ./Mandatory	2	5.263	5.263
Unorgan./Voluntary	2	5.263	5.263
Org./Volun./Mandat.	2	5.263	5.263

REVIEW SESSIONS

Most of the review sessions are taught by instructors or graduate students, who are better trained and have better skills than undergraduate students although the latter can be most effective as well (see Table VIII). Forty percent of the programs use graduate students exclusively, while thirty-one percent use instructors. Some programs, however, combine faculty and students in providing group tutorial services.

Table VIII
Review Sessions

Item	Frequency	% respondents	% total
Instructors	11	31.429	28.947
Students	14	40.000	36.842
Both	6	17.143	15.790
None	4	11.428	10.526

ACADEMIC PROCEDURES

Counseling and academic recommendation procedures are equally important to the success of academic support programs. Minority program managers and teachers are in a good position to judge the strengths and weaknesses of students and to make rational, competent recommendations to academic officers, especially when extenuating circumstances may be involved. Some academic officers, unfamiliar

with the intricacies of academic support, may not understand that non-academic factors may impede academic progress of disadvantaged students. Familial, personal or adjustment problems may interfere. Also, some students may show tremendous progress in review or tutorial sessions, but may need help in study or test-taking skills. Nonetheless, staff will need to interface with academic procedure representatives at some point. As shown in Table IX, only 10% of the respondents indicated that their programs had complete responsibility. Depending on the relationship with the academic officer (dean or provost), making recommendations can be useful. If the academic officer respects and honors the recommendations on students by the minority program staff, this procedure can be effective in retaining promising students. Twenty-six percent of the programs make recommendations and twenty-three percent make recommendations and engage in follow-up activities. Follow-up involves insuring that students follow the course of study recommended or that students transfer to other institutions. Unfortunately, twenty-six percent of the programs responding reported no involvement in academic procedures.

COUNSELING

Counseling, often neglected, can provide important contact between the minority program, the student and the institution. Many support programs provide personal ,career, and academic counseling (see Table X). All of the respondents reported that their programs provide academic counseling, advising students on course selection and requirements. (Faculty serve as academic advisors in 64% of the programs). Ninety-one percent of the participants said their career counseling is provided including after school, summer and permanent employment. Personal counseling requires sensitivity, trust and experience making it perhaps the most important function of a comprehensive counseling program. Counseling requires someone who has had experience keeping records and making referrals without breaking confidence, someone who can "keep a secret" and someone who can detect serious problems. The counselors role is demanding and time consuming, but important to establish confidence and respect by the students in the minority program. Ninety-four percent of the respondents have personal counseling available.

Table X
Counseling

Yes	No	Type	% respond.	% no	% total	% total no
37	0	Academic	100	----	97.36	0
33	3	Career	91.66	8.33	86.84	7.89
34	2	Personal	94.44	5.55	89.47	5.26

TEACHING IN SPECIAL PROGRAMS

Teaching like counseling, although important, can be a weak link in minority program development. What kind of teachers are selected? What kind of experience and credentials do these teachers have? Are teachers experiences with the disadvantaged considered? Good teaching is critical

The minority engineering program survey sought information on the kinds of teachers selected and their teaching preferences. Table XI shows the responses to the question: What kind of teachers are sought for your program? Thirty percent said that program managers look for the best teacher available. Twenty-three percent seek a combination of the best available, most sensitive and experienced. Others chose to emphasize sensitivity and experience as important qualities.

Table XI
Teaching Qualities Sought

Frequency	Quality	% respondents	% total
9	Best available	30.00	23.68
7	Sensit./Exper./Best	23.33	18.42
4	Sensitivity	13.33	10.52
4	Sensit./Exper.	13.33	10.52
2	Experience	6.667	5.263
2	Sensit./Best	6.66	5.26
2	Exper./Best	6.66	5.26
30			

In Table XII, responses on teaching experience and training are indicated. Sixty-eight percent of the respondents

consider themselves adequately prepared to teach in their subject area, but only thirty-seven percent believe they have been adequately trained to teach the disadvantaged.. Seventy percent think special training is necessary. Only twenty-three percent indicate that special training is available through a faculty development program. Understandably there is a need for more training for program faculty to familiarize them with innovative strategies and philosophy. There are three components of a good faculty development program: instructional development, organizational development, and personal development. Berquist states that instructional development includes evaluation, diagnosis, training in traditional and new methods and curriculum development. Organizational development encompasses team building, decision making, problem solving and management development. Personal development encourages career and life planning, discussions about teaching concepts and competencies, interpersonal skills development, personal growth and therapeutic and supportive counseling.

These efforts should be coordinated by the minority program to insure proper organization and continuity. What faculty learn about minority student programs, we suspect, they learn on the job although they have apparently learned

well. Eighty-nine percent of the participants think they have been successful in teaching the disadvantaged. despite the lack of formal preparation in this special area.

Table XII
Teaching Experience and Training

Yes	No	Item	Sample %yes	Sample %no	Population %yes	Population %no
26	12	Adequately prepared	68.421	31.57	68.42	31.57
14	23	Prepared	37.83	62.16	36.84	60.52
26	11	Training necessary	70.27	29.73	68.42	28.94
25	3	Success.w/disadvan.	89.28	10.71	65.78	7.89
8	25	Faculty develop.	23.52	76.47	21.05	68.42
14	--	Complete Ph D.	37.83	-----	36.84	-----
17	--	Complete MA.	45.94	-----	44.73	-----
16	--	Complete BS.	16.21	-----	15.78	-----

Formal training in traditional subject areas is impressive. Of those teachers responding, 37% hold Ph D.'s, 45% have master's degrees, and 16% hold bachelor's degrees.

TEACHING PROCEDURES

Teachers use a variety of teaching strategies and procedures. Often these approaches can make the difference between success and failure because students have different learning styles and rates. The most popular approach is emphasis on basic skills (77%). Here teachers use drill and

repetition and emphasis on discipline and study skills. Sixty-five percent of the respondents saw individualization as an important approach. Teaching machines, computer assisted instruction and providing individual attention are examples of approaches used. Generally, the personalized system of instruction is very popular in engineering institutions. It is not surprising that it has proved useful with special students. This method allows students to proceed through a course at their own pace, reading textbook chapters then taking unit examinations and receiving help from instructors as necessary. Emphasis on concepts proved important to respondents. Sixty-two percent believe that instruction should emphasize concepts, believing, presumably, that many lack a clear understanding of the broad applications and rationale for many of the procedures and operations learned..

Group discussion is a good method for sharing common problems. Group discussions by tutors (51%) and teachers (40%) and students (45%) help to determine which students are having difficulty and need additional help and help discover curricular and programmatic difficulties.

Several methods are moderately popular among special program teachers. Drill and repetition (42%), inquiry (37%), emphasis on knowledge acquisition (34%) and varying teaching styles are valuable methods. The inquiry method is most promising because this method of deductive questioning helps students to think and develop more responsibility for their learning.

Methods not widely used, but promising are; discovery (25%), videotaping lectures (25%), using interdisciplinary studies approaches (20%), team teaching (17%), and audiotaping lectures (17%). These methods have been used in some programs but they require training and experience. Faculty and staff need to develop interpersonal survival skills. Human relations training should be implemented in all programs.

Teachers were asked to rate programmatic areas that they considered most important. Areas considered very important are student interest and motivation (97%), sensitivity of teachers (80%), tutoring sessions (60%), an understandable text (50%), academic counseling (52%), and review sessions. Program managers seeking success should concentrate on the above areas.

Areas considered somewhat important are the grading

system (75%), relating courses to life experience (64%), discussing homework (57%) and training teachers (50%). No areas were considered significantly unimportant.

Table XIII
Teaching Procedures

Frequency	Procedure Used	% of sample resp.	% of sample
27	Basic Skills	77.14	71.05
23	Individualized Instruction	65.71	60.52
22	Personalize Sys. Instruction	62.85	57.89
22	Concepts	62.85	57.89
18	Group Discussion-Tutors	51.42	47.36
16	Group Discussion-Students	45.71	42.10
15	Drill and Repetition	42.85	39.47
14	Group Discussion-Teacher	40.00	36.84
13	Inquiry	37.14	34.21
12	Knowledge Acquisition	34.28	31.57
11	Varying Teaching Style	31.42	28.94
10	Discovery	28.57	26.31
9	Videotape	25.71	23.68
7	Interdisciplinary studies	20.00	18.42
6	Team Teaching	17.14	15.78
6	Audiotape	17.14	15.78
3	Human Relations Training	8.57	7.89

Table XIV
Components Considered Important

Item	% of sample resp.			% of sample		
	vi	si	ni	vi	si	ni
Review Sessions	50.00(16)	50.00(16)	-----	42.10	42.10	-----
Coordinate Prog.	47.05(16)	44.11(16)	8.82(3)	42.10(16)	39.47(15)	7.89(3)
Grading System	15.15(5)	75.75(25)	9.09(3)	13.15(5)	65.78(25)	7.89(3)
Homework Discus.	48.48(16)	51.51(17)	-----	42.10(16)	44.73(17)	-----
Understand. Text	58.82(20)	41.17(18)	-----	52.63(20)	36.84(14)	-----
Relate Life Exp.	29.41(10)	64.70(22)	5.88(2)	26.31(10)	57.89(22)	5.26(2)
Student Int.&Mot.	97.05(33)	2.94(1)	-----	86.84(33)	2.63(1)	-----
Mandat. Tutoring	35.29(12)	47.05(16)	17.64(6)	31.57(12)	42.10(16)	15.79(6)
Academic Counsel.	52.94(18)	47.05(16)	-----	47.36(18)	42.10(16)	-----
Tutoring Sess.	60.00(21)	40.00(14)	-----	55.26(21)	36.84(14)	-----
Training Teach.	41.17(14)	50.00(17)	8.82(3)	36.84(14)	44.23(17)	7.89(3)
Sensit. Teacher	80.00(28)	20.00(7)	-----	73.68(28)	18.42(7)	-----

Assignment of Faculty to Academic Counseling

Frequency	% of resp.	% of sample
Yes-----24	64.86	63.15
No------13	35.13	34.21

The authors looked for relationships among the responses of institutions to determine the connectedness of program components and the viability of aspects of programs. They sought to discover the connections between student retention and teacher training (see Table XV).

Table XV
Relationship: Student Retention/Teacher Training

Adequacy Teacher Preparation	Effectiveness Student Retention: Yes	No	Total
Yes	66.667%	6.666%	73.333%
No	26.667%	-----	26.667%
Total	93.334%	6.66?%	100.000%

There was a 66.667% correlation between those respondents who believed that they had adequate preparation and those who believe they were effective in retaining students. Table XVI shows a low correlation between teachers' preparation to teach the disadvantaged and the programs effectiveness in retaining students.

Table XVI
Relationship: Student Retention/Teacher Training

Preparation Teach. Disadv.	Effectiveness Student Retention		
	Yes	No	Total
Yes	33.333%	3.333%	36.666%
No	60.000%	3.333%	63.333%
Total	93.333%	6.566%	100% *

* adjusted

Table XVII shows an 88% correlation between success in teaching the disadvantaged and student retention. There was a correlation between student retention and teacher credentials.

Table XVII
Relationship Student Retention/Teacher Success

Success Teaching Disadvantaged	Effectiveness Student Retention Yes	No	Total
Yes	88.000%	4.000%	92.000%
No	4.000%	4.000%	8.000%
Total	92.000%	8.000%	100%

Table XVIII shows a relationship between faculty development and student retention.

Table XVIII
Relationship Student Retention/Faculty Development

	Effectiveness Student Retention		
	Yes	No	Total
Yes	29.630%		29.630%
No	62.963%	7.407%	70.320%
Total	92.593%	7.407%	100%

Table XIX shows a higher correlation in this area among teachers with masters degrees than teachers with Ph D.'s

Table XIX
Relationship Student Retention/Teacher Training

Teacher Training (Degree and Area)		Effectiveness Student Retention		
		Yes	No	Total
Ph D.	Education	3.448%	-----	3.448%
	Engineering	10.345%	-----	10.345%
	Mathematics	3.448%	-----	3.448%
	Science	3.448%	-----	3.448%
	Arts	13.793%	-----	13.793%
	Sub-total	34.482%	-----	34.482%
MA/MS	Education	10.345%	-6.897%	17.242%
	Engineering	17.242%	-----	17.242%
	Mathematics	-----	-----	-----
	Science	3.448%	-----	3.448%
	Arts	13.793%	-----	13.793%
	Sub-total	44.828%	6.897%	51.725%
BA/BS	Education	-----	-----	-----
	Engineering	6.897%	-----	6.897%
	Mathematics	-----	-----	-----
	Science	-----	-----	-----
	Arts	6.897%	-----	6.897%
	Sub-total	13.794%	-----	13.794%
	TOTAL	93.103%*	6.897%	100%

* adjusted

Table XX
Relationship Student Retention/Special Teaching Methods

Special Teaching Methods	Effective Student Retention Yes	No	Total
Personalize Sys.	39.474%	2.632%	42.106%
Videotape	13.158%	2.632%	15.790%
Audiotape	10.526%	2.632%	13.158%
Individ. Instr.	44.736%	2.632%	23.684%
Drill & Repet.	21.052%	2.632%	23.684%
Inquiry	28.947%	-----	28.947%
Discovery	28.947%	-----	28.947%
Group Disc.Teach.	28.947%	2.632%	31.578%
Group Disc.Tutor	31.579%	2.632%	34.211%
Group Disc.Stud.	31.579%	-----	31.579%
Interdisc. Study	10.526%	-----	10.526%
Team Teaching	15.789%	-----	15.789%
Basic Skills	44.736%	5.263%	49.999%
Human Relations	7.895%	-----	7.895%
Vary Teach. Style	21.052%	2.632%	23.684%
Knowledge Acquis.	23.684%	-----	23.684%
Concepts	39.474%	2.632%	42.106%

The correlation between special teaching methods an student retention is as follows: individualized instruction (44.736%), basic skills (44.736%), Personalized system of instruction (39.434%) and emphasis on concepts see Table XX).

Table XXIII
Relationship Student Survival/Teacher Training

Teacher Training/Degree & Area		Student Survival Yes	No	Probably	Total
Ph D.	Education	-----	2.778%	-----	2.778%
	Engineering	-----	2.778%	11.111%	13.889%
	Mathematics	-----	-----	2.778%	2.778%
	Science	-----	2.778%	-----	2.778%
	Arts	-----	8.333%	2.778%	11.111%
	Sub-total	-----	16.667%	16.667%	33.334%
MA/MS	Education	-----	13.889%	2.778%	16.667%
	Engineering	5.556%	2.778%	5.556%	13.889%
	Mathematics	-----	2.778%	-----	2.778%
	Science	-----	5.556%	-----	5.556%
	Arts	-----	5.556%	2.778%	8.334%
	Sub-total	5.556%	30.556%	11.112%	47.224%
BA/BS	Education	-----	-----	-----	-----
	Engineering	-----	-----	5.556%	5.556%
	Mathematics	-----	2.778%	-----	2.778%
	Science	-----	-----	-----	-----
	Arts	-----	2.778%	8.333%	11.111%
	Sub-total	-----	5.556%	13.889%	19.445%
	TOTAL	5.556%	52.779%	41.668%	100%*

* adjusted

development and student survival. Thirty-seven percent of the respondents not involved in educational improvement indicated that the program was not successful in retaining students. Also, 37% of the teachers not involved in training programs feel that students would probably survive without their help.

Table XXII
Relationship Student Survival/ Faculty Development

Faculty Development Program	Student Survival Yes	No	Probably	Total
Yes	3.125%	12.500%	6.250%	21.875%
No	3.125%	37.500%	37.500%	78.125%
Total	6.250%	50.000%	43.750%	100%

Is there a relationship between student survival and the level and kind of education of the teacher? Table XXIII shows that teachers with education degrees (13.81%) and arts degrees (8%), were involved in programs that were not as effective in retaining students. Special teaching methods did not always help retention efforts (see Table XXIV). Personalized systems of instruction (36.84%), individualized instruction (42.10%), emphasis on basic skills (39.47%), and emphasis on concepts (28.94%) were not always effective methods in reducing attrition. Table XXV shows that 41% of the teachers who believe that they have been prepared to teach, indicate that their programs have not been successful in retaining students. However, 25% of the same group believe that their students would probably survive. Table XXVI shows that 31% if the teachers who indicated inadequate preparation to teach the disadvantaged, are in programs that have been unsuccessful in retaining the disadvantaged

Table XXIV
Relationship Student Survival/Special Teaching Methods

Special Teaching Methods	Student Survival Yes	No	Probably	Total
Personal. System	2.632%	36.842%	13.158%	52.632%
Videotape	-----	15.789%	7.895%	23.684%
Audiotape	-----	10.526%	2.632%	13.158%
Individ. Instruct.	-----	42.105%	18.421%	60.526%
Drill & Repetit.	2.632%	23.684%	7.895%	34.211%
Inquiry	2.632%	18.421%	10.526%	31.579%
Discovery	2.632%	15.789%	10.526%	28.947%
Group Dis. Teachers	2.632%	21.053%	13.158%	36.843%
Group Dis. Tutors	5.263%	21.053%	18.421%	44.737%
Group Dis. Students	5.263%	10.526%	18.421%	34.210%
Interdisc. Studies	-----	15.789%	2.632%	18.421%
Team Teaching	2.632%	7.895%	5.263%	15.790%
Basic Sk.	2.632%	39.474%	21.053%	63.159%
Human Rel. Training	-----	5.263%	2.632%	7.895%
Vary Teach. Styles	2.632%	18.421%	2.632%	23.685%
Knowledge Acquis.	-----	13.158%	10.526%	23.684%
Concepts	2.632%	28.947%	21.053%	52.632%

Table XXV
Relationship Student Survival/Teacher Training

Adequacy Tchr. Prepar.	Students Survival Yes	No	Probably	Total
Yes	5.556%	41.667%	25.000%	72.223%
No	-----	8.333%	19.444%	27.777%
Total	5.556%	50.000%	44.444%	100%

Table XXVI

Preparation Tch. Disadv.	Students Survival Yes	No	Probably	Total
Yes	2.857%	17.143%	17.143%	37.143%
No	2.857%	31.429%	28.571%	62.857%
Total	5.714%	48.572%	45.714%	100%

Also the researchers sought to determine a connection between the ability to predict academic success and teacher training. In Table XXVII, 35.29% of the teachers who received adequate training were in programs where personnel were able to predict academic success. Thirty-eight percent of the same group were unable to predict academic success.

Table XXVII
Relationship Academic Success/Teacher Training

Predict Academ. Success	Adequacy Teacher Training Preparation Yes	No	Total
Yes	35.294%	20.589%	55.883%
No	38.235%	5.882%	44.117%
Total	73.529%	26.471%	100%

Table XXVIII shows that 38% of the teachers who had been trained to teach the disadvantaged were in programs not able to retain students. In Table XXIX, 55.55% of the teachers who were successful in teaching the disadvantaged were able to predict academic success.

Table XXVIII
Relationship Academic Success/Teacher Training

Predict Acad.Success	Preparation Teaching Disadvantaged Yes	No	Total
Yes	17.647%	38.235%	55.882%
No	17.647%	26.471%	44.118%
Total	35.294%	64.706%	100%

Table XXIX
Relationship Academic Success/Teacher Success

Predict Acad.Success	Successful Teaching Disadvantaged Yes	No	Total
Yes	55.556%	3.703%	59.259%
No	37.038%	3.703%	40.741%
Total	92.594%	7.406%	100%

In Table XXX, 41.93% of the teachers without faculty development programs were able to predict academic success, while 32.25% of those teachers with no faculty development

Program, were not able to predict academic success.

Table XXX
Relationship Academic Success/Faculty Development

Predict Academic Success	Faculty Development Program Yes	No	Total
Yes	12.903%	41.936%	54.839%
No	12.903%	32.258%	45.161%
Total	25.806%	74.194%	100%

In Table XXXI, Ph D. holders in Engineering (9.091%), were able to predict academic success, but Ph D. recipients in arts (9.091%) were not able to predict success. Nine percent each ,of the masters recipients in Education and Engineering were able to predict success. Table XXXII shows a correlation between special teaching methods and academic success. Programs emphasizing the following strategies were able to predict academic success: personalized system of instruction (23.684%), individualized instruction (26.316%), emphasis on basic skills (23.684%). Other programs emphasizing the following methods were not able to predict academic success.

Table XXXI
Relationship Academic Success/Teacher Training

Teacher Training (Degree+ Area)	Academic Success (Predict) Yes	No	Total	
Education	-----	3.030%	3.030%	
Engineering	9.091%	6.061%	15.152%	
Mathematics	3.030%	-----	3.030%	Ph.D.
Science	3.030%	-----	3.030%	
Arts	3.030%	9.091%	12.122%	
Sub-total	18.182%	18.182%	36.364%	
Education	9.091%	6.061%	15.152%	
Engineering	9.091%	6.061%	15.152%	
Mathematics	-----	-----	-----	MA/MS
Science	3.030%	3.030%	6.060%*	
Arts	6.061%	6.060%	12.121%*	
Sub-total	27.273%	21.212%	48.485%	
Education	-----	-----	-----	
Engineering	6.060%	-----	6.060%	
Mathematics	-----	-----	-----	BA/BS
Science	-----	-----	-----	
Arts	6.060%	3.030%	9.091%*	
Sub-total	12.121%	3.030%	15.151%	
TOTAL	57.576%	42.424%	100%	

* adjusted

Table XXXII
Relationship Academic Success/Special Teaching Methods

Special Teaching Methods.....	Academic Success (Predict) Yes	No	Total
Personalized System	23.684%	23.684%	47.368%
Videotape	10.526%	10.526%	21.052%
Audiotape	5.263%	7.895%	13.158%
Individualized Instr.	26.316%	28.947%	55.263%
Drill & Repetition	15.789%	10.526%	26.315%
Inquiry	18.421%	10.526%	28.947%
Discovery	18.421%	10.526%	28.947%
Group Discussion-Teach.	15.789%	18.421%	34.210%
Group Discussion-Tutor	18.421%	23.684%	42.105%
Group Discussion-Stud.	15.789%	18.421%	34.210%
Interdiscip. Studies	10.526%	2.632%	13.158%
Team Teaching	10.526%	5.263%	15.789%
Basic Skills	28.947%	28.947%	57.894%
Human Relations Train.	5.263%	5.263%	10.526%
Vary Teaching Styles	10.526%	13.158%	23.684%
Knowledge Acquisition	15.789%	10.526%	26.315%
Emphasis Concepts	23.684%	21.052%	44.736%

* % equal % total sample

These programs used personalized systems of instruction (23.684%), individualized instruction (28.947%), emphasis on basic skills (28.947%), and emphasis on concepts (21.052%).

DISCUSSION

Teaching the disadvantaged is an important factor in minority engineering programs. Special programs are receiving more attention nationwide as evidenced by Table I. Several states not reporting, perhaps, do not have significant or well identified minority engineering programs. Some programs are well integrated within the mainstream of institutional activities, so programs are not clearly identified. The states reporting represent areas with significant industrial activities and minority populations-areas most likely to have minority engineering programs.

Good teachers are able to assess the abilities of students to provide appropriate instruction. However, teachers in different disciplines use different criteria for measuring abilities. With entering freshmen, some teachers emphasize all or some of the following criteria: scholastic aptitude tests, high school grades, diagnostic tests, recommendations, achievement tests and intuition. Other teachers refuse to use any criteria believing that it will prejudice their assessment of the students abilities..

Assuming that all minority engineering programs have a similar mission-to graduate engineering students, that teachers and administrators should be able to measure program effectiveness. However, in some cases, the immediate goal of some programs may be merely to prepare students for a particular field of study. Then, it is up to the individual departments to help students. Many instructors in the departments are not prepared to meet the special needs of disadvantaged students.

Often, programs must be managed properly in order to be successful. Support of central administrators and departments is essential. Experienced and effective teachers and students should be encouraged to participate in support activities. Ongoing training must be an essential part of that process. Central administrators, department chairpersons, and key teachers must be invited to participate in orientation and training sessions. Faculty and administrators involved in the academic review process are likely to be more knowledgeable, if not sympathetic as a result of participation in special training sessions.

It is important to emphasize that teachers must

experiment with a variety of teaching strategies. However, these approaches must be carefully researched before attempted. It is not always possible to become proficient in using a particular method through colleagues, over coffee. If the approach is carefully researched, introduced properly, and continued, it should be effective. If it is not sufficiently effective, it should be discontinued with that particular group. Table XIII shows that all of the methods have had some effectiveness with some students. If one approach will help 20% of the students understand a particular concept, it should be used with that group. Vary your teaching style; if one approach does not work, try another. Table XXIV shows some correlation between student survival and teaching method. If 5% more students can be retained by using a particular method, it should be used! For each of the concepts to be introduced, several approaches should be outlined prior to the class session.

Why some respondents considered some program components more important than others is open to question. Had the method been proven effective or was it merely the most

familiar to the individual. We suggest that methods were selected or not selected because they were effective or ineffective. For example, students invariably complain that they have been graded unfairly, i.e., that other students received higher grades for the same number of correct answers on an examination or that some students were allowed to make up examinations while others were not, resulting in poor grades for the latter group. Grading has been a political football for some time and will continue to be a problem. Our advice to teachers is to tell students to avoid compromising situations. In short, these are the areas that teachers feel are important.

RECOMMENDATIONS

Those managers developing new programs or seeking ways to improve existing programs should seriously look at the teaching component. Based on program experience and the results of this study, the authors offer the following eight recommendations. First, special program staff should be given a larger role in academic actions. Institutions must make an effort to include special program staff in academic procedures to avoid feelings of alienation. Appointments to academic committees, academic teaching appointments, and appointments as academic officers such as assistant dean, associate provost and vice president of academic affairs are important steps. Many of the solutions that effect special programs can benefit the institutions as well. Students will percieve the teaching staff as "real" teachers and the program as a bona fide organ of the institution-something of which to be proud.

Second, every program should have a faculty development component. This mechanism would provide training for new faculty and serve to retain experienced faculty. Information on innovative teaching applications, problem solving

techniques and literature would be useful. Peter Seldin states that a faculty development program would include (a) a financial incentive program, (b) lectures on common problems, (c) in service courses and (d) a feedback program. However, faculty and staff must provide much of the energy and direction for the program to have a lasting effect. Projects are most effective that allow faculty an opportunity to attend seminars, conduct research on teaching, to try out new ideas in a laboratory format, and share new ideas through discussion. Resource centers run by faculty are important. Kenneth Eble believes that successful resource centers should (a) involve senior faculty in non-major courses, (b) encourage team teaching and (c) foster interest in philosophy of education and require supervision of training programs. Least effective are one shot lectures and administrator run programs. Dennis Stickdale and Zachary Wochok report that several institutions use special methods .The University of Illinois and Texas Christian University use videotape to provide feedback on problems and techniques of teaching. Other schools use an audiotutorial approach. These techniques work with students as well. General training for teachers and graduate students is provided at the University of Utah,

the University of Colorado, Brown University and Sam Houston State University.

Third, graduate students must be involved in training programs. Stockdale and Wochok report in "Why Not Train Teachers to Teach" in Improving College and University Teaching, that Washington University has a four year Ph D. program where graduate students are required to (a) observe faculty teach, (b) to review the literature on teaching and (c) to be supervised while teaching for two years.

Fourth, development of programmatic procedures and models that are best suited for your institution and your program is essential. Mandatory tutoring may work in a community college setting, but not in an Ivy League institution. Try new techniques on small groups before making large committments of time and resources. Although the approaches may vary, the nature and intention of academic support must be to improve educational applications and retention.

Fifth, clear goals and objectives should be outlined. Goals and objectives should indicate long range and short range strategies for implementing plans consistent with institutional policy. Managers should prepare drafts

of goals with staff and share them with superiors.

Sixth, implement programs that are operational and measurable. Programs should be feasible and able to be carried out by designated staff. More importantly, staff should be encouraged to use their expertise in a variety of areas. Professional advancement should be encouraged. At Cornell University several minority engineering staff members are working on advanced degrees in engineering, business and mathematics.

Seventh, cooperation with area school districts to share information on engineering, learn more about public school curriculum and to develop contact with potential applicants is important. Teacher exchange and visitation programs, joint projects, engineering exposure lectures, career conferences and sponsored field trips work well.

Eighth, establish evaluation procedures for faculty and staff that are tied to programmatic evaluation. Be sure that faculty and staff are encouraged to upgrade skills, develop new courses, and team teach in interdisciplinary situations. Faculty review should be conducted by peers and administrators using a mutually agreed upon format.

These suggestions will help program managers upgrade the skills of faculty and staff. We have enclosed a list of recommended reading for additional help. For more detailed information write to us at the address below.

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Administrators and faculty must begin to understand that performances will be measured differently in the decades to come. Educating above average students to become leaders has been important and should remain so. But institutions will be measured by the strength of their special programs as well. That is the real test. Educating students who do not meet the traditional profile can demonstrate the diversity, intelligence and committment of higher education to affirmative action and to a democratic society.

RECOMMENDATIONS

We have several recommendations based on the information obtained from the survey:

1. Special program staff must become more involved in academic actions by participating in decision making groups who decide on academic actions for students, such as a "policies and procedures review committee," or "admissions and standards committee."

2. Special program staff must seek tenured faculty positions to become truly integrated into the mainstream of the institution, to add legitimacy to program curricula, and to encourage a better understanding of academia.

3. Use a variety of teaching applications to meet the needs of all students. Read educational journals such as, Educational Leadership, Change, Theory into Practice, Today's Education, The Journal of Higher Education, and Educational Record, emphasize programmatic precedures that are most effective for your program, e.g., emphasize some of the procedures mentionaed in Table XIII. If these items prove effective, maintain them.

4. Provide on-going training for faculty and staff, introducing innovative teaching and programmatic techniques.

5. Comprehensive programs seem to work best. Interface with various departments on campus. Develop joint programs with the media center, the library and other academic departments to train personnel in areas such as peer-tutoring and counseling, professional counseling and tutoring and volunteer counseling and tutoring.

6. Establish criteria for hiring competent staff according to program goals and establish staff development to upgrade faculty competencies.

7. Establish multi-level programs. Institutions with undergraduate programs should initiate pre-college projects by working with admissions officers, public schools or other colleges. Pre-college project directors should work with post-secondary institutions to share resources.

8. Special programs should develop in-house and other professional diagnostic instruments to document program success and help to predict success and failure, cooperating with the department of psychology or the test and measurement staff on campus.

9. Establish an on-going evaluation of faculty and staff as well as the students, with periodic discussion and follow-up.

10. Know your students. Be flexible.

11. Teach students abstracting and generalizing skills.

12. Use interdisciplinary approaches.

13. Peter Hampton insists that the here and now can be most relevant for students.

14. Provide enough financial aid to relieve tension. If you you suggest that students take a reduced load, have the funds to provide summer tuition for make-up classes.

15. Use multi-media: films, pictures, overhead projectors and demonstration techniques.

16. Ann and Ali Engrin underscore the necessity to accept differences in skills and abilities as well as limitations of listeners to memorize information.

17. Teachers and managers must provide opportunities for success and rewards for students while simultaneously providing challenging experiences; i.e., certification for completion of special programs and awards for excellence.

18. Pace learning efforts of students.

19. Teach concepts, not merely facts.

20. Do not underestimate disadvantaged students. They have the ability.

21. Build on previous learning tasks in logical sequence.

22. Easily understood concepts should be taught first, even if it means changing the study sequence of chapters.

23. Encourage auxilliary learning activities.

24. Disseminate lecture notes in advance or write a brief outline on the blackboard.

25. Review lectures at the end of each class session.

26. Wilbert McKeachie encourages teachers to organize group discussions of 'hot' issues.

27. Hovland, Kelley and Janis caution educators to present both sides of issues in lectures.

28. Use group discussions to (a) get feedback on class content, (b) to involve members of the class, (c) to encourage additional study, (d) to stimulate thinking, (e) to help students to think logically and (f) to validate information and to help students apply theoretical information.

29. The group laboratory method has proved more successful than the lecture according to J.R. White. McKeachie urges teachers to use laboratory teaching, independent study, programmed learning and role playing to help teachers.

30. Gerry Gaff encourages teachers to give explicit homework assignments.

31. Rehearse lectures and look for non-verbal responses.

32. Melvin Le Baron cautions teachers of the marginal student to help those students unfamiliar with competitive environments to overcome fear.

33. Use other methods to evaluate teacher effectiveness. Teachers cannot always measure effectiveness through high grades. Perhaps students would have gotten high grades anyway.

34. Frank Reissman argues that successful teachers of the disadvantaged (1) like to teach, (2) are concerned with teaching students not merely disseminating content, (3) are teachers who identify with and understand the problems of the disadvantaged and (4) are dedicated teachers.

35. John Choma lists the following tips for teachers. Successful teachers must define the parameters of a good engineering education; (a) good teachers help students to gain confidence so that they can tackle problems, even unfamiliar problems, long after graduation, (b) there is a need to develop trust between students and teachers, (c) encourage student questions, such as why one technigue was introduced instead of another and what are the future applications of such techniques, (d) homework should not be tedious, but should amplify other learning and (e) academic counseling should be conducted on a regular basis.

36. Teachers should be encouraged to teach outside of areas of competency, in new settings such as informal residence hall seminars, teach-ins and experimental learning situations.

37. Teachers must conduct research and write about teaching and learning.

38. Assume the role of change agent.

39. Do not expect stupidity and failure in students.

40. Pullias says good teaching depends on the personality of the instructor, e.g., integrity, enthusiasm, directness, imagination and concern for the learner.

41. Understand the purpose of teaching: to serve as a mediator between content and student.

42. James Jordin wants teachers to keep changing and modifying ideas.

43. Recognize the overwhelming dissatisfaction among students with teaching and the quality of instruction.

44. Joseph Axelrod believes that teachers must understand the socio-economic forces within society that cause problems such as the correlation between family income and educational opportunity.

45. The teacher needs to become an artist above and beyond the mastery of skills.

46. Greenfield and Page want us to utilize closed circuit television (CCTV) and electro-writers.

47. Avoid authoritarian approaches exclusively.

48. Avoid spoonfeeding students.

49. Observe other teachers.

50. Attend seminars on instructional improvement.

51. Encourage an annual review of tenured faculty.

52. Avoid dependance on student evaluation to measure teacher effectiveness, unless special training for students in evaluation technique is offered.

53. Interview teachers and students about problems.

54. Encourage interdisciplinary discussions among teachers.

55. David Brown and William Hanger suggest that faculty: (a) run for public office, (b) do volunteer work, (c) consult, or (d) prepare school brochures to develop a new perspective on teaching and learning.

56. Sikes lists two important reminders: (a) use existing resources such as lecture series, speakers bureaus and equipment and (b) use competency based curricula.

57. Ferron and White list four tips for educators: (1) faculty development programs should encourage seeking out those who need help, then provide resources, (2) focus on behavior, not evaluation. In peer observation the observer should supply the data to allow teachers to draw conclusions. (3) bag lunch seminars encourage faculty sharing and (4) develop a self-help checklist.

58. Invite distinguished professor awards recipients to conduct workshops.

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